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Classification of Grand Fir Mosaic Habitats

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Research Summary

Grand Fir Mosaic habitats differ from adjacent forest habitats in their slow rate of secondary succession to woody vegetation. Approximately 500,000 acres of Grand Fir Mosaic habitats occur in northern Idaho in an elevation range between 4,200 and 6,000 ft. Previously forested sites are rapidly invaded by bracken fern (*Pteridium aquilinum*), western coneflower (*Rudbeckia occidentalis*), and other forbs. Pocket gopher (*Thomomys talpoides*) populations also increase rapidly in previously forested sites, and their predation impedes the process of secondary succession to woody species. This investigation of the possibility of identifying the Grand Fir Mosaic through vegetative and site indicators used five habitat types, an elevation range, and indicator plant species to develop a key that identifies Grand Fir Mosaic habitats. Such identification will enable land managers to prescribe practices appropriate to these sites.

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Grand Fir Mosaic habitats occur in upland forests above tributaries of the Clearwater River in northern Idaho. The Grand Fir Mosaic derives its name from *Abies grandis* (grand fir), the dominant conifer, and a mosaic of sizes and shapes of natural nonforested openings. *Alnus sinuata* (Sitka alder), *Pteridium aquilinum* (bracken fern), *Rudbeckia occidentalis* (western coneflower), or *Menziesia ferruginea* (fools huckleberry) are the dominant species found in these natural openings. Investigations on these habitats were initiated because of poor conifer regeneration success and the unusually slow rate of secondary succession to woody vegetation (Ferguson 1991; Ferguson and Adams 1994; Sommer 1991).

The Grand Fir Mosaic encompasses approximately 500,000 acres in northern Idaho at elevations primarily between 4,500 and 5,500 ft, but as low as 4,200 ft and as high as 6,000 ft. The predominant habitat type is *Abies grandis/Asarum caudatum*, a cool-moist habitat (defined by Cooper and others 1991), which has three phases: *Menziesia ferruginea*, *Taxus brevifolia*, and *Asarum caudatum*.

The number of conifer species in the Grand Fir Mosaic is limited when compared to adjacent forest habitats. Following *Abies grandis* in abundance are *Picea engelmannii* (Engelmann spruce), *Thuja plicata* (western redcedar), and *Abies lasiocarpa* (subalpine fir). *Pseudotsuga menziesii* var. *glauca* (Douglas-fir), *Pinus monticola* (western white pine), and *Larix occidentalis* (western larch) are infrequent. Elevations in the Grand Fir Mosaic are generally too high to support *Pinus ponderosa* (ponderosa pine), and *Tsuga mertensiana* (mountain hemlock) is found only in certain locations in the Grand Fir Mosaic. Interestingly, *Pinus contorta* (lodgepole pine) grows at higher and lower elevations adjacent to the Grand Fir Mosaic, but is rare in the Mosaic itself.

Many herbaceous species become established following major disturbances. *Pteridium aquilinum* and *Rudbeckia occidentalis* have the highest amounts of above- and below-ground biomass (Ferguson and Adams 1994). *Pteridium aquilinum* and *Rudbeckia occidentalis* reach heights of 5 to 6 ft, and *Pteridium aquilinum* has densities of 116,000 fronds per acre at a Grand Fir Mosaic study site (Znerold 1979). *Pteridium aquilinum* is more abundant than *Rudbeckia occidentalis* in northern parts of the Grand Fir Mosaic, while *Rudbeckia occidentalis* is more abundant in southern parts.

In addition to copious amounts of *Pteridium aquilinum* and *Rudbeckia occidentalis*, pocket gophers (*Thomomys talpoides*) inhabit natural openings in the forest canopy. Their populations expand rapidly into previously forested sites. Three factors might contribute to high gopher populations: deep soils that contain volcanic ash, adequate soil moisture during the summer months, and the establishment of forb communities.

Gophers tunnel through the soil feeding on forbs, shrubs, and trees (Teipner and others 1983), which substantially impedes the process of secondary succession. Entire plantations of trees have been killed by gophers. Ferguson and Adams (1994), from study sites in the Grand Fir Mosaic, showed that after 3 years gopher-caused mortality to planted trees ranged from 36.7 percent for *Picea engelmannii* to 55.0 percent for *Abies lasiocarpa*.

While the Grand Fir Mosaic contains several cool, moist habitat types, all of them also occur outside of the Mosaic. Thus, habitat type and phase descriptions of Cooper and others (1991) do not provide enough information to determine whether or not a forest stand is in the Mosaic. More information is needed for land managers to be able to identify Grand Fir Mosaic forests. Managers can then determine the best practices for these sites, which may be quite different from those for non-Grand Fir Mosaic sites. See Ferguson and others (in preparation) for further discussion and management recommendations.

This report provides a key and descriptions that classify late seral to climax Grand Fir Mosaic forest communities into one of three categories—in the Grand Fir Mosaic, not in the Mosaic, or transitional. This classification is a refinement of "Forest habitat types of northern Idaho: a second approximation," by Cooper and others (1991).

Methods and Analyses

Most of the data needed for this study had been previously collected for the northern Idaho habitat type manual (Cooper and others 1991). We collected

additional information by determining whether Cooper and others' stands were in the Grand Fir Mosaic. Stands within the geographic area of the Mosaic were examined in the summer of 1990. Sampling was restricted to the Nez Perce, Clearwater, and St. Joe National Forests and to habitat types in and adjacent to the Grand Fir Mosaic.

Unless otherwise noted, we included all phases of habitat types for sampling. The most commonly encountered habitat type in the Grand Fir Mosaic is *Abies grandis/Asarum caudatum*. Other habitat types found at slightly higher or lower elevations and on different topographic positions include *Abies grandis/Senecio triangularis*, *Thuja plicata/Asarum caudatum*, *Tsuga mertensiana/Streptopus amplexifolius*, and *Abies lasiocarpa/Streptopus amplexifolius*. Habitat types considered as possibly being in the Mosaic were *Abies grandis/Clintonia uniflora-Taxus brevifolia* phase, *Thuja plicata/Clintonia uniflora*, *Tsuga heterophylla/Asarum caudatum*, and *Abies lasiocarpa/Calamagrostis canadensis*.

Original field data of Cooper and others (1991) contain a species list, species coverage, legal and geographic location, and directions for locating the stand. It was not necessary to reestablish plot boundaries because the Grand Fir Mosaic occurs in elevation zones rather than isolated patches, and we only had to determine whether the stand and surrounding area were within the Mosaic. Areas near sample stands were visited to determine succession following harvest, to examine natural forest openings, and to note how vegetation changed with elevation, aspect, and topographic position.

Three categories were used to classify stands:

1. Not in the Mosaic
2. Transitional Mosaic to non-Mosaic
3. In the Mosaic

We prepared constancy and coverage tables to compare plots in these three categories. Constancy is the percentage of plots in a particular habitat type on which a species occurs. Coverage is the average percent canopy coverage for those plots on which the species is found. For example, if five plots contain coverages for *Picea engelmannii* of 10, 0, 20, 0, and 0 percent; constancy would be 40 percent and average coverage 15 percent. To keep the key compatible with Cooper and others (1991), we used their definitions for cover classes: present (≥5 scattered individuals per 0.10 acre plot not occurring on microsites), common (≥1 percent), well represented (≥5 percent), and abundant (≥25 percent).

Appendix A is a list of the species included in our analyses.

Results

During the summer of 1990, we visited and classified 96 of 112 possible stands. The 16 stands not used in the analyses were either not located with certainty or were at remote locations that we did not visit. Of the 96 stands, 70 were not in the Grand Fir Mosaic, 12 were transitional, and 14 were in the Grand Fir Mosaic. Figure 1 shows locations of the 96 stands, and table 1 shows the 96 stands by habitat type, phase, and Mosaic classification.

For analyses, and to be on the conservative side, stands classified as transitional were combined with stands in the Grand Fir Mosaic. The presence or absence of species was given highest priority in developing keys because of the ease of determination by the user. A lower priority was given to percent coverage, and the lowest priority was given to combinations of species or summation of coverages for more than one species. Choosing easily identifiable indicator species was also desirable. For example, species of *Carex* are poor choices for indicator species because they are so difficult to differentiate.

Table 2 is a classification key to Grand Fir Mosaic habitats. Constancy and coverage data for each couplet in table 2 are given in appendix B. Couplet 1 in the key defines habitat types on which the Grand Fir Mosaic occurs. They are *Abies grandis/Asarum caudatum*, *Abies grandis/Senecio triangularis*, *Thuja plicata/Asarum caudatum*, *Abies lasiocarpa/Streptopus amplexifolius*, and *Tsuga mertensiana/Streptopus amplexifolius*.

Couplet 2 defines the range of elevations for the Mosaic: as low as 4,200 ft and as high as 6,000 ft. Figure 2 is a frequency distribution showing the number of stands sampled by elevation and Grand Fir Mosaic classification. We expect that the Grand Fir Mosaic will be quite rare outside the 4,200 to 6,000 ft elevational range.

Couplet 3 identifies four species that indicate non-Mosaic conditions: *Cornus canadensis*, *Pyrola asarifolia*, *Pyrola picta*, and *Vaccinium scoparium*. Whenever *Cornus canadensis* or *Vaccinium scoparium* were found, stands were not in the Mosaic. *Pyrola asarifolia* or *Pyrola picta* are good indicators of non-Mosaic habitats, but they can occasionally be found on Grand Fir Mosaic sites. *Cornus canadensis* and the two *Pyrolas* identify sites that are likely warmer or drier than Mosaic sites, while *Vaccinium scoparium* identifies sites colder than the Mosaic.

Couplet 4 identifies the two most important indicator species in the Grand Fir Mosaic—*Actaea rubra* and *Synthyris platycarpa*. *Actaea rubra* is distributed beyond the Grand Fir Mosaic, but occurrences outside the Mosaic are nearly eliminated by couplets 1, 2, and 3.

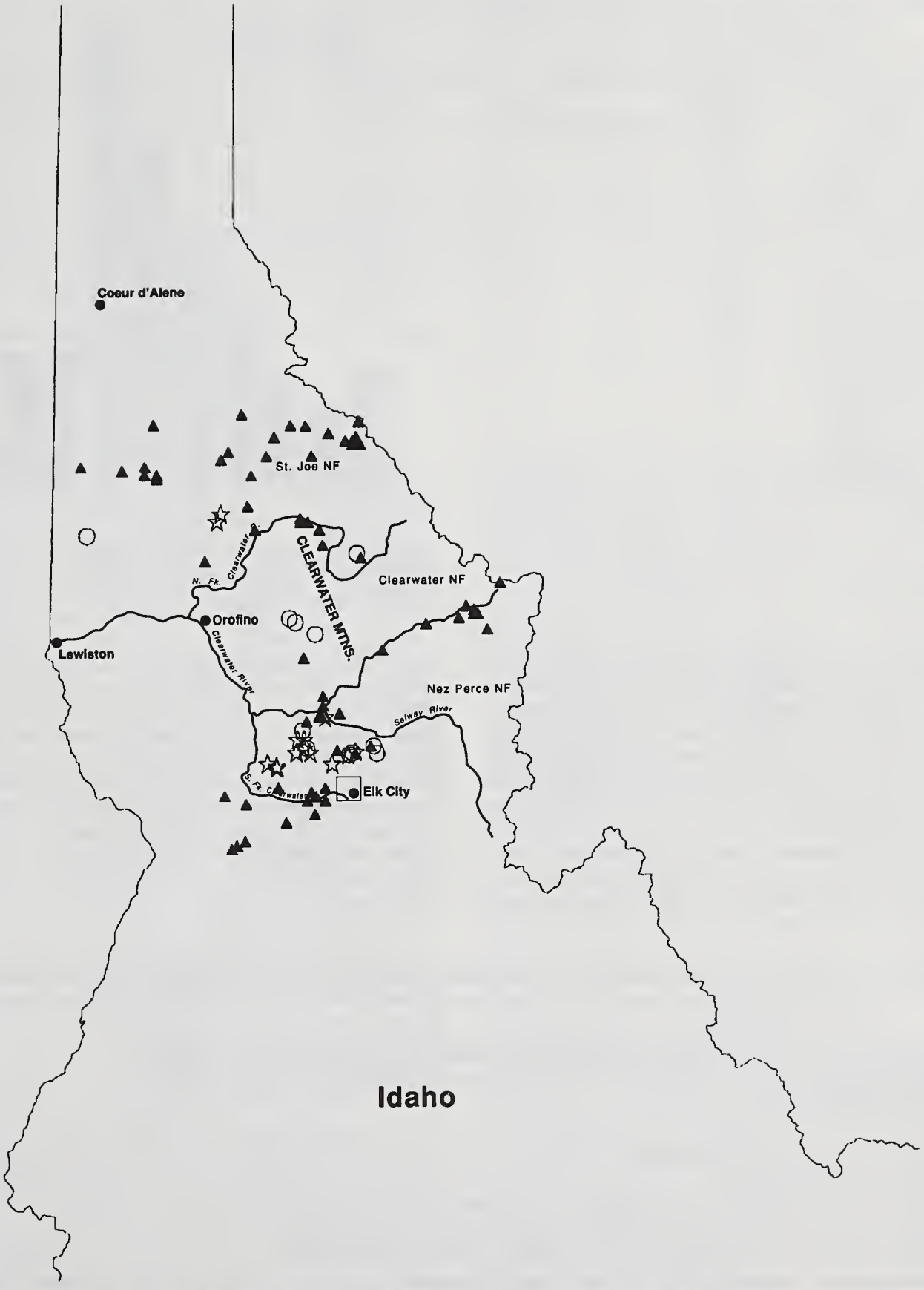

Figure 1—Location of 96 stands used in developing the key for Grand Fir Mosaic habitats. Triangles are stands not in the Mosaic, open circles are transitional, and stars are stands in the Mosaic.

Table 1—Number of stands by habitat type and Grand Fir Mosaic classification. See appendix A for identification of species abbreviations.

Habitat type and phase	Not in the Mosaic	Transitional	In the Mosaic
ABGR/ASCA-ASCA	12	4	2
ABGR/ASCA-MEFE	2	1	2
ABGR/ASCA-TABR	5		5
ABGR/CLUN-TABR	1		
ABGR/SETR			1
THPL/CLUN-CLUN	2		
THPL/CLUN-MEFE	1		
THPL/ASCA-ASCA	25	2	2
THPL/ASCA-MEFE	5		
THPL/ASCA-TABR	1	2	
TSHE/ASCA-ASCA	5		
ABLA/STAM-MEFE	2		2
ABLA/STAM-LICA	5	2	
ABLA/CACA-VACA	1		
TSME/STAM-LUHI	2	1	
TSME/STAM-MEFE	1		
Totals	70	12	14

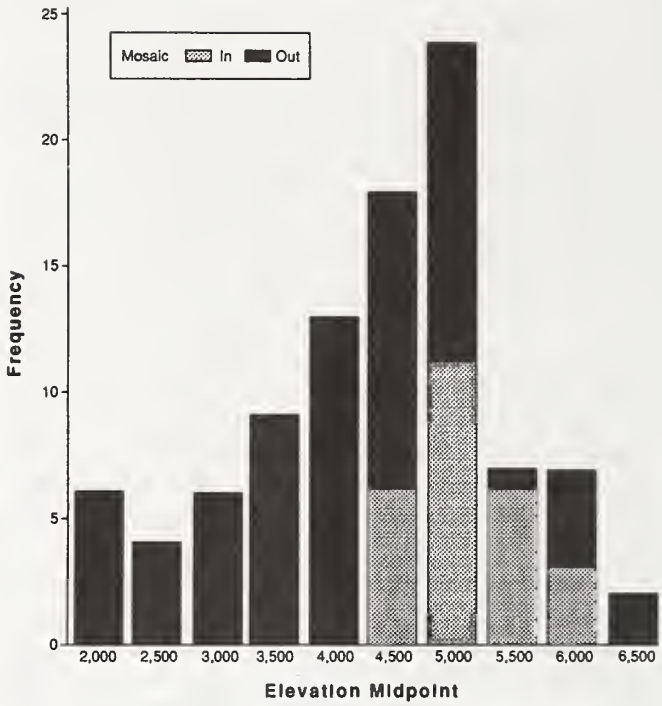

Figure 2—Frequency distribution for 96 sampled stands by elevation and whether they were in or out of the Grand Fir Mosaic.

Synthyris platycarpa has exceptionally high fidelity with the Grand Fir Mosaic. Fidelity is a quantification of exclusiveness of a particular species to a habitat type or group of habitat types. If *Synthyris platycarpa* occurs, the area is in or near the Grand Fir Mosaic. The distribution of *Synthyris platycarpa*, identified by Crawford (1980), is almost wholly within the Grand Fir Mosaic.

Three disadvantages arise with using *Synthyris platycarpa* as an indicator species. First, it can occur at slightly higher and lower elevations than the Grand Fir Mosaic. Second, within the range of *Synthyris platycarpa*, its presence is not assured on 0.10-acre plots. Third, the range of *Synthyris platycarpa* is smaller than the range of Grand Fir Mosaic habitats. *Synthyris platycarpa* is most abundant on the Nez Perce National Forest with a smaller population on the Clearwater National Forest (Crawford 1980). This means that most stands on the Clearwater and all on the St. Joe National Forest probably lack *Synthyris platycarpa*.

Table 2—Key to the Grand Fir Mosaic habitats. This key can be used in late seral to climax forest stands in and adjacent to the Nez Perce, Clearwater, and southern St. Joe National Forests in Idaho. Habitat types follow Cooper and others (1991), and plot size is 0.10 acre.

1. Habitat type one of the following: *Abies grandis/Asarum caudatum*, *Abies grandis/Senecio triangularis*, *Thuja plicata/Asarum caudatum*, *Abies lasiocarpa/Streptopus amplexifolius*, or *Tsuga mertensiana/ Streptopus amplexifolius*	Couplet 2
1. Habitat type not as above	Not in Grand Fir Mosaic
2. Elevation less than 4,200 ft or greater than 6,000 ft	Not in Grand Fir Mosaic
2. Elevation 4,200 ft to 6,000 ft	Couplet 3
3. *Cornus canadensis*, *Pyrola asarifolia*, *Pyrola picta*, or *Vaccinium scoparium* present (≥5 scattered individuals per plot, not restricted to microsites)	Not in Grand Fir Mosaic
3. *Cornus canadensis*, *Pyrola asarifolia*, *Pyrola picta*, and *Vaccinium scoparium* absent	Couplet 4
4. *Actaea rubra* well represented (≥5%) or *Synthyris platycarpa* present	In the Grand Fir Mosaic
4. *Actaea rubra* present but <5% and *Synthyris platycarpa* absent	Transitional
4. *Actaea rubra* and *Synthyris platycarpa* absent	Not in Grand Fir Mosaic

Table 3—Supporting evidence: the Grand Fir Mosaic habitats can be identified by the following additional characteristics, although all may not be present.

1. *Alnus sinuata* stringers on moist hillsides and in draws. *Pteridium aquilinum* is often found under the *Alnus sinuata*. See the description of *Alnus sinuata* communities and the *Alnus sinuata/Montia cordifolia* habitat type in Cooper and others (1991).
2. *Pteridium aquilinum* glades that are quite old (few trees, little woody vegetation except patches of *Menziesii ferruginea*, *Alnus sinuata*, *Sambucus racemosa*, and/or *Acer glabrum*).
3. *Pinus contorta* is absent or rare, although it commonly grows at higher and/or lower elevations adjacent to the Mosaic.
4. In areas where the forest canopy has been removed, such as from harvesting, there is rapid invasion by *Pteridium aquilinum*, and *Rudbeckia occidentalis*. *Pteridium aquilinum* has higher coverage than *Rudbeckia occidentalis* on the Clearwater and St. Joe National Forests. *Rudbeckia occidentalis* has higher coverage than *Pteridium aquilinum* on the Nez Perce National Forest.
5. Some species will have lower percentage occurrences within the Grand Fir Mosaic, while others will have higher occurrences. Compare species compositions to figures in appendix C.
6. All investigated sites have volcanic ash soils that typically have an umbrept epipedon, which is a thick dark-colored surface horizon.

Discussion

Identification of the Grand Fir Mosaic refines the habitat type classification of Cooper and others (1991), which does not identify the Grand Fir Mosaic. Land managers must be able to identify the Mosaic and recognize its unique management needs because of the slow rate of succession to woody species. This classification provides a key and descriptive information that makes it possible to recognize a stand in the Mosaic.

The key to the Grand Fir Mosaic works reasonably well. Couplets 1, 2, and 3 exclude stands that are not in the Mosaic. Couplet 4 focuses on *Actaea rubra* and *Synthyris platycarpa*, two indicator species for the Grand Fir Mosaic. *Actaea rubra* can be found on other habitat types and at different elevations, but it is highly correlated with Mosaic conditions once a stand meets the conditions of couplets 1, 2, and 3. The occurrence of *Synthyris platycarpa* nearly coincides with the Grand Fir Mosaic. If *Synthyris platycarpa* is found, the location is likely to be in the Mosaic.

Reliance on *Actea rubra* and *Synthyris platycarpa* as indicators of the Grand Fir Mosaic could lead to error because neither species has 100 percent constancy on 0.10-acre plots in the Mosaic. This disadvantage will be minimized by closely examining vegetation near the plot and observing other vegetational clues in the area.

It is not unreasonable to expect that Mosaic and non-Mosaic stands may be similar. If striking differences were readily apparent, Cooper and others (1991) would probably have noticed this during their sampling and analyses. The fact that there are nearly as many transitional stands in the sample as there are Grand Fir Mosaic stands shows that identification of the Grand Fir Mosaic is not a deterministic process. Even indicator species can overlap Mosaic and non-Mosaic areas. Thus, consideration of the elevational and vegetational restrictions, coupled with other characteristics of the locality (see table 3 and appendix C), should reduce the chance of classification error.

New research provides clues to Grand Fir Mosaic and non-Mosaic conditions. Johnson-Maynard (1995) investigated a Grand Fir Mosaic site on the Clearwater National Forest. Treatments were an uncut forest, adjacent clearcut that had been invaded by *Pteridium aquilinum* and *Rudbeckia occidentalis*, and an old *Pteridium aquilinum* glade. Two different soil-forming processes were found. The two treatments dominated by *Pteridium aquilinum* had high levels of aluminum-humus complexes that resulted from the annual cycling of large amounts of organic matter in forb-dominated communities. The aluminum that occurs in these soils through the weathering of volcanic ash remains readily available to plants in aluminum-humus complexes. Weathering of aluminum from volcanic ash under forested conditions was the second soil-forming process, which resulted in formation of allophane (aluminum-silica clays). Aluminum in allophane is much less available to plants than aluminum in aluminum-humus complexes.

Formation of aluminum-humus complexes is probably a key reason for the slow succession to woody species in the Grand Fir Mosaic. Interaction of climate, topography, and volcanic ash produces conditions conducive to formation of aluminum-humus complexes in forest openings. These complexes cause nutrient imbalances and, quite possibly, aluminum toxicity. Gradations to higher or lower elevations, with accompanying warm/dry or cold/wet climates, would cause transition areas between Mosaic and non-Mosaic conditions. More definitive tests can be developed to categorize Mosaic and non-Mosaic sites as underlying causes of Mosaic conditions become known.

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Appendix A—Species Included in Analyses

Code	Scientific name
Trees	
ABGR	*Abies grandis*
ABLA	*Abies lasiocarpa*
LAOC	*Larix occidentalis*
PICO	*Pinus contorta*
PIEN	*Picea engelmannii*
PIMO	*Pinus monticola*
PIPO	*Pinus ponderosa*
PSME	*Pseudotsuga menziesii*
THPL	*Thuja plicata*
TSHE	*Tsuga heterophylla*
TSME	*Tsuga mertensiana*
Shrubs	
ACGL	*Acer glabrum*
ALSI	*Alnus sinuata*
AMAL	*Amelanchier alnifolia*
CLCO	*Clematis columbiana*
HODI	*Holodiscus discolor*
LIBO	*Linnaea borealis*
LOCI	*Lonicera ciliosa*
LOIN	*Lonicera involucrata*
LOUT	*Lonicera utahensis*
MEFE	*Menziesii ferruginea*
PAMY	*Pachistima myrsinites*
PHMA	*Physocarpus malvaceus*
RHPU	*Rhamnus purshiana*
RILA	*Ribes lacustre*
RIVI	*Ribes viscosissimum*
ROGY	*Rosa gymnocarpa*
RUNI	*Rubus nivalis*
RUPA	*Rubus parviflorus*
SARA	*Sambucus racemosa*
SASC	*Salix scouleriana*
SOSC	*Sorbus scopulina*
SPBE	*Spiraea betulifolia*
SYAL	*Symphoricarpos albus*
TABR	*Taxus brevifolia*
VAGL	*Vaccinium globulare*
VASC	*Vaccinium scoparium*
Perennial forbs	
ACRU	*Actaea rubra*
ADBI	*Adenocaulon bicolor*
ANPI	*Anemone piperi*
ANRA	*Antennaria racemosa*
ARCO	*Arnica cordifolia*
ARLA	*Arnica latifolia*
ARMA	*Arenaria macrophylla*
ASCA	*Asarum caudatum*
ASCO	*Aster conspicuus*
CHME	*Chimaphila menziesii*
CHUM	*Chimaphila umbellata*
CIAL	*Circaea alpina*

Code	Scientific name
Perennial forbs	
CLUN	*Clintonia uniflora*
COCA	*Cornus canadensis*
COOC	*Coptis occidentalis*
DIHO	*Disporum hookeri*
DITR	*Disporum trachycarpum*
FRVE	*Fragaria vesca*
GATR	*Galium triflorum*
GOOB	*Goodyera oblongifolia*
HIAL	*Hieracium albiflorum*
LANE	*Lathyrus nevadensis*
LICA	*Ligusticum canbyi*
LIVE	*Ligusticum verticillatum*
MIPE	*Mitella pentandra*
MIST	*Mitella stauropetala*
MOUN	*Monotropa uniflora*
OSCH	*Osmorhiza chilensis*
PEBR	*Pedicularis bracteosa*
PERA	*Pedicularis racemosa*
POPU	*Polemonium pulcherrimum*
PYAS	*Pyrola asarifolia*
PYPI	*Pyrola picta*
PYSE	*Pyrola secunda*
SETR	*Senecio triangularis*
SMRA	*Smilacina racemosa*
SMST	*Smilacina stellata*
STAM	*Streptopus amplexifolius*
SYPL	*Synthyris platycarpa*
THOC	*Thalictrum occidentale*
TITR	*Tiarella trifoliata*
TRCA	*Trautvetteria caroliniensis*
TROV	*Trillium ovatum*
VASI	*Valeriana sitchensis*
VEVI	*Veratrum viride*
VICA	*Viola canadensis*
VIGL	*Viola glabella*
VIOR	*Viola orbiculata*
XETE	*Xerophyllum tenax*
Ferns and allied taxa	
ADPE	*Adiantum pedatum*
ATFI	*Athyrium filix-femina*
DRAU	*Dryopteris austriaca*
GYDR	*Gymnocarpium dropteris*
POMU	*Polystrichum munitum*
PTAQ	*Pteridium aquilinum*
Graminoids	
BRVU	*Bromus vulgaris*
CARO	*Carex rossii*
CARU	*Calamagrostis rubescens*
FEOC	*Festuca occidentalis*
LUHI	*Luzula hitchcockii*

Appendix B—Constancy and Coverage Tables

Constancy and percent canopy coverage by species and Grand Fir Mosaic classification for the 96 plots used in this study.

	70 Plots not in mosaic		26 Plots in mosaic	
	Constancy	Coverage	Constancy	Coverage
ABGR	85.71	30.0	88.46	32.6
ABLA	30.00	20.9	26.92	24.3
LAOC	42.86	9.7	11.54	7.7
PICO	20.00	21.7	0.00	0.0
PIEN	48.57	14.9	61.54	18.6
PIMO	25.71	9.2	7.69	15.0
PIPO	8.57	8.3	3.85	10.0
PSME	65.71	21.4	30.77	17.9
THPL	58.57	30.5	50.00	21.3
TSHE	7.14	34.0	0.00	0.0
TSME	10.00	16.6	3.85	40.0
ACGL	64.29	9.0	88.46	11.3
ALSI	15.71	7.4	26.92	8.6
AMAL	48.57	2.2	34.62	3.0
CLCO	12.86	2.0	11.54	1.0
HODI	20.00	6.2	7.69	2.0
LIBO	62.86	9.9	7.69	5.5
LOCI	17.14	1.7	7.69	1.0
LOIN	7.14	1.0	3.85	1.0
LOUT	68.57	2.9	53.85	2.3
MEFE	40.00	15.6	65.38	13.5
PAMY	38.57	8.8	15.38	1.0
PHMA	8.57	5.5	7.69	2.0
RHPU	17.14	2.7	0.00	0.0
RILA	21.43	2.2	34.62	3.1
RIVI	10.00	3.7	7.69	2.0
ROGY	68.57	3.9	46.15	2.6
RUNI	7.14	1.0	0.00	0.0
RUPA	42.86	5.8	61.54	2.2
SARA	5.71	1.5	30.77	1.0
SASC	7.14	1.0	0.00	0.0
SOSC	27.14	1.5	42.31	2.6
SPBE	34.29	1.8	15.38	3.2
SYAL	54.29	6.7	53.85	4.4
TABR	24.29	14.2	53.85	19.6
VAGL	70.00	9.1	88.46	11.7
VASC	8.57	15.5	0.00	0.0
ACRU	25.71	1.8	61.54	9.9
ADBI	60.00	4.9	65.38	5.9
ANPI	72.86	2.4	84.62	2.2
ANRA	5.71	5.7	0.00	0.0
ARCO	8.57	18.7	7.69	1.0
ARLA	32.86	11.5	61.54	18.4
ARMA	22.86	3.4	46.15	1.9
ASCA	80.00	4.2	84.62	7.7
ASCO	5.71	3.2	7.69	1.0
CHME	24.29	1.6	30.77	1.0

(con.)

Appendix B (Con.)

	70 Plots not in mosaic		26 Plots in mosaic	
	Constancy	Coverage	Constancy	Coverage
CHUM	55.71	2.2	19.23	2.8
CIAL	5.71	5.7	34.62	4.0
CLUN	91.43	7.5	92.31	6.3
COCA	41.43	7.1	0.00	0.0
COOC	85.71	14.4	80.77	11.8
DIHO	61.43	7.3	65.38	5.5
DITR	5.71	3.2	7.69	1.0
FRVE	37.14	1.4	19.23	2.8
GATR	70.00	2.7	84.62	2.2
GOOB	57.14	1.3	46.15	1.2
HIAL	41.43	1.0	30.77	1.2
LANE	5.71	1.0	3.85	1.0
LICA	10.00	6.3	3.85	10.0
LIVE	4.29	1.7	7.69	2.0
MIPE	10.00	6.3	3.85	1.0
MIST	31.43	1.0	26.92	2.3
MOUN	7.14	1.4	3.85	1.0
OSCH	57.14	1.4	69.23	1.6
PEBR	4.29	1.0	7.69	1.0
PERA	12.86	1.0	7.69	1.0
POPU	11.43	2.1	23.08	2.5
PYAS	28.57	1.4	7.69	1.0
PYPI	24.29	1.1	7.69	2.0
PYSE	41.43	1.4	26.92	1.0
SETR	22.86	7.9	46.15	2.5
SMRA	25.71	1.6	15.38	1.0
SMST	90.00	5.7	84.62	4.0
STAM	11.43	1.2	19.23	1.0
SYPL	5.71	3.2	50.00	5.5
THOC	61.43	1.6	76.92	5.2
TITR	67.14	5.4	76.92	4.6
TRCA	11.43	14.4	7.69	30.0
TROV	68.57	1.2	96.15	1.0
VASI	10.00	2.3	15.38	1.0
VEVI	15.71	7.0	26.92	1.0
VICA	12.86	2.0	7.69	5.5
VIGL	22.86	2.9	46.15	4.7
VIOR	72.86	3.1	73.08	2.4
XETE	48.57	7.8	46.15	1.9
ADPE	14.29	1.9	0.00	0.0
ATFI	25.71	4.2	38.46	8.9
DRAU	4.29	1.7	30.77	1.0
GYDR	11.43	3.4	0.00	0.0
POMU	37.14	6.4	34.62	2.2
PTAQ	32.86	2.7	42.31	2.8
BRVU	80.00	4.1	92.31	1.8
CARO	1.43	1.0	11.54	1.0
CARU	12.86	4.2	0.00	0.0
FEOC	7.14	2.8	0.00	0.0
LUHI	5.71	15.2	3.85	20.0

(con.)

Appendix B (Con.)

Constancy and percent canopy coverage after removing non-Grand Fir Mosaic habitat types (couplet 1 in table 2).

	61 Plots not in mosaic		26 Plots in mosaic	
	Constancy	Coverage	Constancy	Coverage
ABGR	83.61	30.9	88.46	32.6
ABLA	32.79	21.4	26.92	24.3
LAOC	42.62	9.8	11.54	7.7
PICO	19.67	20.9	0.00	0.0
PIEN	47.54	15.6	61.54	18.6
PIMO	24.59	9.0	7.69	15.0
PIPO	8.20	8.0	3.85	10.0
PSME	70.49	21.7	30.77	17.9
THPL	55.74	30.6	50.00	21.3
TSHE	0.00	0.0	0.00	0.0
TSME	11.48	16.6	3.85	40.0
ACGL	67.21	9.6	88.46	11.3
ALSI	18.03	7.4	26.92	8.6
AMAL	49.18	2.4	34.62	3.0
CLCO	14.75	2.0	11.54	1.0
HODI	22.95	6.2	7.69	2.0
LIBO	60.66	8.9	7.69	5.5
LOCI	14.75	2.0	7.69	1.0
LOIN	6.56	1.0	3.85	1.0
LOUT	68.85	3.0	53.85	2.3
MEFE	39.34	16.1	65.38	13.5
PAMY	36.07	9.3	15.38	1.0
PHMA	9.84	5.5	7.69	2.0
RHPU	19.67	2.7	0.00	0.0
RILA	22.95	2.3	34.62	3.1
RIVI	11.48	3.7	7.69	2.0
ROGY	68.85	4.1	46.15	2.6
RUNI	6.56	1.0	0.00	0.0
RUPA	47.54	6.0	61.54	2.2
SARA	6.56	1.5	30.77	1.0
SASC	8.20	1.0	0.00	0.0
SOSC	29.51	1.5	42.31	2.6
SPBE	34.43	2.0	15.38	3.2
SYAL	59.02	7.0	53.85	4.4
TABR	24.59	13.3	53.85	19.6
VAGL	70.49	8.9	88.46	11.7
VASC	8.20	10.6	0.00	0.0
ACRU	27.87	1.8	61.54	9.9
ADBI	57.38	5.7	65.38	5.9
ANPI	73.77	2.6	84.62	2.2
ANRA	6.56	5.7	0.00	0.0
ARCO	9.84	18.7	7.69	1.0
ARLA	34.43	12.4	61.54	18.4
ARMA	24.59	3.5	46.15	1.9
ASCA	83.61	4.5	84.62	7.7
ASCO	6.56	3.2	7.69	1.0
CHME	24.59	1.6	30.77	1.0

(con.)

Appendix B (Con.)

	61 Plots not in mosaic		26 Plots in mosaic	
	Constancy	Coverage	Constancy	Coverage
CHUM	49.18	1.6	19.23	2.8
CIAL	6.56	5.7	34.62	4.0
CLUN	90.16	7.5	92.31	6.3
COCA	39.34	7.2	0.00	0.0
COOC	85.25	14.8	80.77	11.8
DIHO	63.93	8.0	65.38	5.5
DITR	6.56	3.2	7.69	1.0
FRVE	37.70	1.5	19.23	2.8
GATR	75.41	2.8	84.62	2.2
GOOB	57.38	1.1	46.15	1.2
HIAL	45.90	1.0	30.77	1.2
LANE	6.56	1.0	3.85	1.0
LICA	9.84	5.7	3.85	10.0
LIVE	4.92	1.7	7.69	2.0
MIPE	9.84	7.2	3.85	1.0
MIST	34.43	1.0	26.92	2.3
MOUN	6.56	1.0	3.85	1.0
OSCH	62.30	1.5	69.23	1.6
PEBR	4.92	1.0	7.69	1.0
PERA	13.11	1.0	7.69	1.0
POPU	11.48	2.3	23.08	2.5
PYAS	26.23	1.6	7.69	1.0
PYPI	24.59	1.1	7.69	2.0
PYSE	37.70	1.6	26.92	1.0
SETR	24.59	8.3	46.15	2.5
SMRA	26.23	1.7	15.38	1.0
SMST	91.80	6.1	84.62	4.0
STAM	9.84	1.0	19.23	1.0
SYPL	4.92	4.0	50.00	5.5
THOC	65.57	1.7	76.92	5.2
TITR	65.57	4.5	76.92	4.6
TRCA	13.11	14.4	7.69	30.0
TROV	67.21	1.2	96.15	1.0
VASI	11.48	2.3	15.38	1.0
VEVI	14.75	8.1	26.92	1.0
VICA	11.48	2.3	7.69	5.5
VIGL	24.59	3.1	46.15	4.7
VIOR	70.49	2.9	73.08	2.4
XETE	49.18	5.8	46.15	1.9
ADPE	16.39	1.9	0.00	0.0
ATFI	24.59	4.7	38.46	8.9
DRAU	4.92	1.7	30.77	1.0
GYDR	8.20	4.8	0.00	0.0
POMU	40.98	6.3	34.62	2.2
PTAQ	31.15	3.1	42.31	2.8
BRVU	81.97	4.4	92.31	1.8
CARO	1.64	1.0	11.54	1.0
CARU	14.75	4.2	0.00	0.0
FEOC	8.20	2.8	0.00	0.0
LUHI	6.56	15.2	3.85	20.0

(con.)

Appendix B (Con.)

Constancy and percent canopy coverage after removing plots outside the elevation range of 4,200 to 6,000 ft (couplet 2 in table 2).

	27 Plots not in mosaic		26 Plots in mosaic	
	Constancy	Coverage	Constancy	Coverage
ABGR	81.48	32.4	88.46	32.6
ABLA	40.74	20.5	26.92	24.3
LAOC	51.85	10.9	11.54	7.7
PICO	22.22	11.8	0.00	0.0
PIEN	55.56	18.1	61.54	18.6
PIMO	18.52	10.6	7.69	15.0
PIPO	11.11	2.3	3.85	10.0
PSME	66.67	19.4	30.77	17.9
THPL	44.44	37.5	50.00	21.3
TSHE	0.00	0.0	0.00	0.0
TSME	14.81	26.0	3.85	40.0
ACGL	51.85	7.3	88.46	11.3
ALSI	22.22	7.7	26.92	8.6
AMAL	29.63	2.1	34.62	3.0
CLCO	11.11	1.0	11.54	1.0
HODI	7.41	1.0	7.69	2.0
LIBO	51.85	7.8	7.69	5.5
LOCI	7.41	1.0	7.69	1.0
LOIN	3.70	1.0	3.85	1.0
LOUT	66.67	2.1	53.85	2.3
MEFE	62.96	17.4	65.38	13.5
PAMY	44.44	7.4	15.38	1.0
PHMA	0.00	0.0	7.69	2.0
RHPU	0.00	0.0	0.00	0.0
RILA	25.93	2.3	34.62	3.1
RIVI	11.11	7.3	7.69	2.0
ROGY	51.85	2.4	46.15	2.6
RUNI	7.41	1.0	0.00	0.0
RUPA	33.33	6.3	61.54	2.2
SARA	11.11	1.0	30.77	1.0
SASC	7.41	1.0	0.00	0.0
SOSC	25.93	2.3	42.31	2.6
SPBE	18.52	2.8	15.38	3.2
SYAL	40.74	2.6	53.85	4.4
TABR	33.33	19.4	53.85	19.6
VAGL	77.78	8.1	88.46	11.7
VASC	11.11	4.0	0.00	0.0
ACRU	33.33	1.4	61.54	9.9
ADBI	40.74	5.2	65.38	5.9
ANPI	81.48	2.7	84.62	2.2
ANRA	0.00	0.0	0.00	0.0
ARCO	14.81	17.7	7.69	1.0
ARLA	37.04	12.4	61.54	18.4
ARMA	25.93	1.0	46.15	1.9
ASCA	81.48	4.4	84.62	7.7
ASCO	11.11	4.0	7.69	1.0
CHME	33.33	1.0	30.77	1.0

(con.)

Appendix B (Con.)

	27 Plots not in mosaic		26 Plots in mosaic	
	Constancy	Coverage	Constancy	Coverage
CHUM	48.15	1.0	19.23	2.8
CIAL	7.41	10.5	34.62	4.0
CLUN	88.89	6.9	92.31	6.3
COCA	33.33	5.0	0.00	0.0
COOC	88.89	14.0	80.77	11.8
DIHO	44.44	3.3	65.38	5.5
DITR	7.41	1.0	7.69	1.0
FRVE	25.93	1.0	19.23	2.8
GATR	66.67	1.0	84.62	2.2
GOOB	62.96	1.1	46.15	1.2
HIAL	29.63	1.0	30.77	1.2
LANE	11.11	1.0	3.85	1.0
LICA	11.11	4.0	3.85	10.0
LIVE	0.00	0.0	7.69	2.0
MIPE	22.22	7.2	3.85	1.0
MIST	37.04	1.0	26.92	2.3
MOUN	3.70	1.0	3.85	1.0
OSCH	59.26	1.6	69.23	1.6
PEBR	7.41	1.0	7.69	1.0
PERA	7.41	1.0	7.69	1.0
POPU	22.22	2.5	23.08	2.5
PYAS	37.04	1.0	7.69	1.0
PYPI	33.33	1.2	7.69	2.0
PYSE	33.33	1.2	26.92	1.0
SETR	25.93	9.6	46.15	2.5
SMRA	22.22	1.3	15.38	1.0
SMST	92.59	4.3	84.62	4.0
STAM	11.11	1.0	19.23	1.0
SYPL	7.41	5.5	50.00	5.5
THOC	66.67	1.5	76.92	5.2
TITR	77.78	4.7	76.92	4.6
TRCA	11.11	13.7	7.69	30.0
TROV	81.48	1.0	96.15	1.0
VASI	11.11	1.0	15.38	1.0
VEVI	11.11	10.3	26.92	1.0
VICA	14.81	1.0	7.69	5.5
VIGL	22.22	2.8	46.15	4.7
VIOR	70.37	2.9	73.08	2.4
XETE	74.07	4.9	46.15	1.9
ADPE	3.70	1.0	0.00	0.0
ATFI	25.93	2.6	38.46	8.9
DRAU	7.41	2.0	30.77	1.0
GYDR	0.00	0.0	0.00	0.0
POMU	22.22	2.5	34.62	2.2
PTAQ	18.52	1.0	42.31	2.8
BRVU	77.78	2.0	92.31	1.8
CARO	0.00	0.0	11.54	1.0
CARU	3.70	1.0	0.00	0.0
FEOC	3.70	1.0	0.00	0.0
LUHI	7.41	25.0	3.85	20.0

(con.)

Appendix B (Con.)

Constancy and percent canopy coverage after removing plots with *Cornus canadensis*, *Pyrola asarifolia*, *Pyrola picta*, or *Vaccinium scoparium* (couplet 3 in table 2).

	3 Plots not in mosaic		23 Plots in mosaic	
	Constancy	Coverage	Constancy	Coverage
ABGR	66.67	26.5	86.96	33.0
ABLA	33.33	30.0	30.43	24.3
LAOC	66.67	6.5	8.70	6.5
PICO	0.00	0.0	0.00	0.0
PIEN	33.33	20.0	60.87	18.4
PIMO	0.00	0.0	4.35	10.0
PIPO	33.33	1.0	4.35	10.0
PSME	100.00	13.7	30.43	19.0
THPL	33.33	60.0	43.48	18.6
TSHE	0.00	0.0	0.00	0.0
TSME	33.33	3.0	4.35	40.0
ACGL	33.33	3.0	91.30	11.9
ALSI	33.33	1.0	30.43	8.6
AMAL	66.67	1.0	34.78	3.2
CLCO	33.33	1.0	13.04	1.0
HODI	0.00	0.0	8.70	2.0
LIBO	33.33	10.0	8.70	5.5
LOCI	0.00	0.0	8.70	1.0
LOIN	0.00	0.0	4.35	1.0
LOUT	66.67	1.0	56.52	2.4
MEFE	33.33	50.0	65.22	14.6
PAMY	0.00	0.0	13.04	1.0
PHMA	0.00	0.0	4.35	1.0
RHPU	0.00	0.0	0.00	0.0
RILA	0.00	0.0	34.78	3.4
RIVI	0.00	0.0	8.70	2.0
ROGY	33.33	1.0	43.48	2.9
RUNI	0.00	0.0	0.00	0.0
RUPA	0.00	0.0	65.22	2.3
SARA	33.33	1.0	34.78	1.0
SASC	0.00	0.0	0.00	0.0
SOSC	33.33	10.0	43.48	2.8
SPBE	33.33	10.0	17.39	3.2
SYAL	33.33	1.0	52.17	5.0
TABR	33.33	3.0	52.17	20.9
VAGL	66.67	15.0	86.96	11.9
VASC	0.00	0.0	0.00	0.0
ACRU	33.33	3.0	60.87	11.1
ADBI	66.67	5.5	60.87	5.6
ANPI	100.00	1.0	86.96	2.3
ANRA	0.00	0.0	0.00	0.0
ARCO	0.00	0.0	8.70	1.0
ARLA	33.33	20.0	60.87	17.5
ARMA	33.33	1.0	47.83	2.0
ASCA	66.67	10.5	82.61	7.8
ASCO	0.00	0.0	8.70	1.0
CHME	33.33	1.0	26.09	1.0

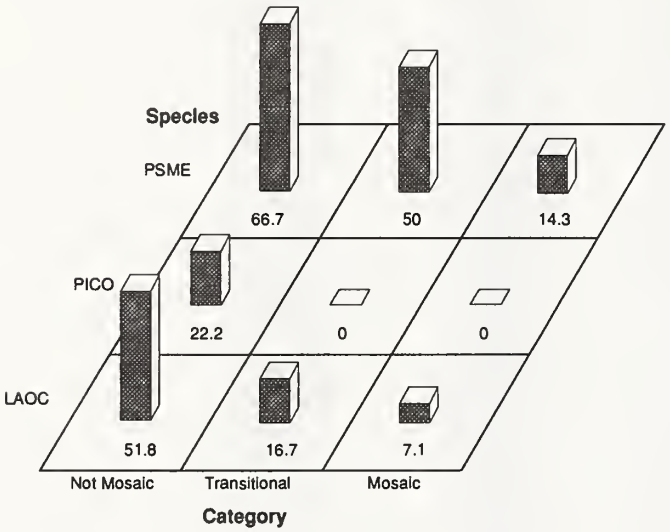
(con.)

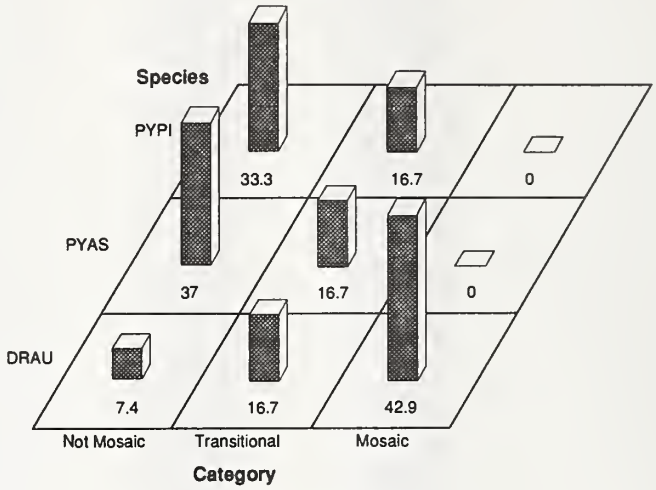
Appendix B (Con.)

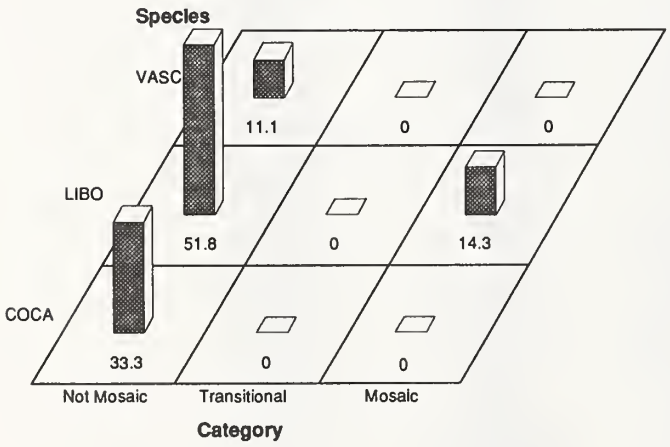
	3 Plots not in mosaic		23 Plots in mosaic	
	Constancy	Coverage	Constancy	Coverage
CHUM	33.33	1.0	17.39	1.0
CIAL	33.33	20.0	39.13	4.0
CLUN	100.00	4.0	91.30	5.8
COCA	0.00	0.0	0.00	0.0
COOC	100.00	4.7	78.26	10.9
DIHO	33.33	10.0	60.87	5.9
DITR	33.33	1.0	8.70	1.0
FRVE	33.33	1.0	21.74	2.8
GATR	100.00	1.0	82.61	2.4
GOOB	66.67	1.0	47.83	1.2
HIAL	33.33	1.0	26.09	1.3
LANE	33.33	1.0	4.35	1.0
LICA	0.00	0.0	4.35	10.0
LIVE	0.00	0.0	8.70	2.0
MIPE	33.33	1.0	4.35	1.0
MIST	33.33	1.0	21.74	2.8
MOUN	0.00	0.0	0.00	0.0
OSCH	66.67	5.5	73.91	1.1
PEBR	0.00	0.0	8.70	1.0
PERA	0.00	0.0	8.70	1.0
POPU	0.00	0.0	26.09	2.5
PYAS	0.00	0.0	0.00	0.0
PYPI	0.00	0.0	0.00	0.0
PYSE	0.00	0.0	26.09	1.0
SETR	33.33	1.0	52.17	2.5
SMRA	0.00	0.0	13.04	1.0
SMST	100.00	7.0	86.96	3.8
STAM	33.33	1.0	21.74	1.0
SYPL	0.00	0.0	52.17	5.8
THOC	33.33	1.0	78.26	5.7
TITR	100.00	7.3	78.26	4.6
TRCA	0.00	0.0	8.70	30.0
TROV	100.00	1.0	95.65	1.0
VASI	0.00	0.0	17.39	1.0
VEVI	33.33	1.0	30.43	1.0
VICA	0.00	0.0	8.70	5.5
VIGL	66.67	5.5	47.83	4.3
VIOR	100.00	4.0	69.57	1.6
XETE	66.67	1.0	47.83	2.0
ADPE	0.00	0.0	0.00	0.0
ATFI	33.33	1.0	39.13	9.8
DRAU	33.33	3.0	34.78	1.0
GYDR	0.00	0.0	0.00	0.0
POMU	33.33	1.0	34.78	1.2
PTAQ	0.00	0.0	47.83	2.8
BRVU	100.00	1.0	91.30	1.0
CARO	0.00	0.0	8.70	1.0
CARU	33.33	1.0	0.00	0.0
FEOC	0.00	0.0	0.00	0.0
LUHI	0.00	0.0	4.35	20.0

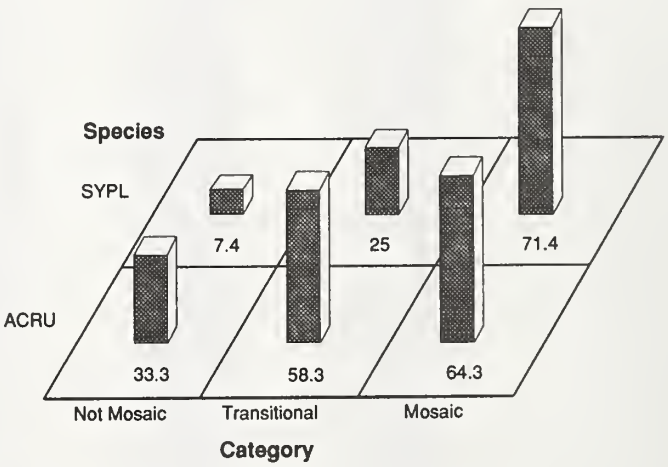
Appendix C—Percentage Occurrence for Selected Species

The following four graphs help identify Mosaic versus non-Mosaic conditions. Figures are based on 53 of the 96 plots (27 non-Mosaic, 12 transitional, and 14 Mosaic plots). Plots that were eliminated to develop these figures were non-Mosaic habitat types and plots outside the elevation range 4,200 to 6,000 ft. See appendix A for identification of species abbreviations.





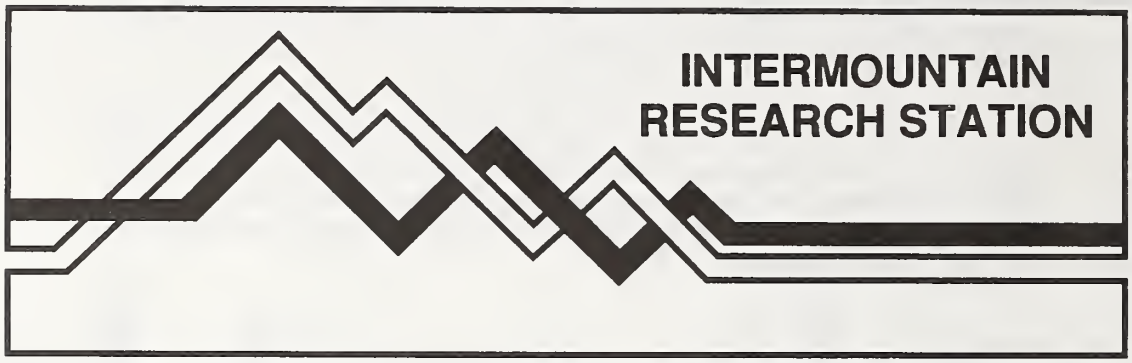




Ferguson, Dennis E.; Johnson, Frederic D. 1996. Classification of Grand Fir Mosaic habitats. Gen. Tech. Rep. INT-GTR-337. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 16 p.

Five habitat types, an elevation range, and plant indicator species were used to develop a key to Grand Fir Mosaic habitats. These habitats have a slow rate of secondary succession to woody vegetation. Successful management begins with proper identification, which will then allow land managers to prescribe appropriate practices. This paper discusses the process of developing the key and provides supporting information to confirm sites that are part of the Grand Fir Mosaic.

Keywords: habitat types, forest succession, forest planning, Clearwater River, northern Idaho



The Intermountain Research Station provides scientific knowledge and technology to improve management, protection, and use of the forests and rangelands of the Intermountain West. Research is designed to meet the needs of National Forest managers, Federal and State agencies, industry, academic institutions, public and private organizations, and individuals. Results of research are made available through publications, symposia, workshops, training sessions, and personal contacts.

The Intermountain Research Station territory includes Montana, Idaho, Utah, Nevada, and western Wyoming. Eighty-five percent of the lands in the Station area, about 231 million acres, are classified as forest or rangeland. They include grasslands, deserts, shrublands, alpine areas, and forests. They provide fiber for forest industries, minerals and fossil fuels for energy and industrial development, water for domestic and industrial consumption, forage for livestock and wildlife, and recreation opportunities for millions of visitors.

Several Station units conduct research in additional western States, or have missions that are national or international in scope.

Station laboratories are located in:

Boise, Idaho

Bozeman, Montana (in cooperation with Montana State University)

Logan, Utah (in cooperation with Utah State University)

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